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Standards

ASTM B349/B349M-03

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ASTM B349/B349M-03 Standard Specification for Zirconium Sponge and Other Forms of Virgin Metal for Nuclear Application

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1. Scope

1.1 This specification covers one grade of virgin zirconium metal commonly designated as sponge because of its porous, sponge-like texture, but it may also take other forms such as chunklets.

1.2 The one grade described is designated as Reactor Grade R60001, suitable for use in nuclear applications. The main characteristic of the reactor grade is its low nuclear cross section as achieved by removal of hafnium. The manufacturer must use procedures to prevent contamination with other high cross-section materials.

1.3 Unless a single unit is used, for example corrosion mass gain in mg/dm², the values stated in either inch-pound or SI units are to be regarded separately as standard. The values stated in each system are not exact equivalents; therefore each system must be used independently of the other. SI values cannot be mixed with inch-pound values.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

Index Terms

nuclear; virgin zirconium metal; zirconium sponge; ICS Number Code 27.120.99; 77.120.99; 77.150.99

Citing ASTM Standards

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Designation: B 349 - 93

Standard Specification for Zirconium Sponge and Other Forms of Virgin Metal for Nuclear Application¹

This standard is issued under the final designation B 349; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last revision. A superscript (n) indicates an editorial change since the last revision or approval.

1. Scope

This specification covers virgin zirconium metal commonly designated as sponge because of its porous, spongy structure, but it may also take other forms such as chips.

The grade is described which is designated as Reactor Grade 0001, suitable for use in nuclear application. The important characteristic of the reactor grade is its low cross section as achieved by removal of hafnium and quality control in manufacturing procedures to contamination with other high cross-section metals.

Values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Document

2.1 ASTM Standards

Standard for Using Significant Digits in Test Data to Assess Conformance with Specifications²

3. Ordering Information

When ordering for material under this specification, the following information, as required, to identify the desired material:

- a. Quantity,
- b. Form of material,
- c. Designation, and
- d. Designation and year of issue.

When ordering designation is as follows: 5000 lb reactor grade 0001, ASTM Specification B 349 - 93.

In addition to the data specified in 3.1, the following information of agreement between the manufacturer and purchaser shall be specified in the purchase order, if applicable:

- a. Heat treatment (Section 14), and
- b. Number of samples (see 6.2).

4. Manufacture

Zirconium metal is usually prepared by reduction of zirconium tetrachloride, and gets its physical characteristics involved in production. These characteristics

may be expected to vary greatly with manufacturing methods. This specification, however, is not limited to metal prepared by reduction of tetrachloride or to material of any specific physical form.

4.2 Only virgin zirconium metal, in identified, uniform, well-mixed blends, shall be supplied under this specification.

5. Chemical Composition

5.1 The zirconium metal supplied under this specification shall conform to the requirements for chemical composition prescribed in Table 1.

6. Sampling

6.1 A blend of sponge shall be sampled by running a full quantity through a proportioner or splitter to obtain a representative sample of at least 1 % of the blend weight. The method for splitting this sample and preparing an evaluation ingot and compacted briquette shall be agreed upon between the manufacturer and the purchaser. One such method is by splitting using a Jones rifle.

6.1.1 The evaluation ingot shall be greater than 30 lb (14 kg).

6.1.2 The compacted briquette shall be at least 1 lb (0.5 kg).

6.2 When specified in the purchase order, a duplicate sample or portions of the briquette and evaluation ingot shall be supplied to the purchaser.

7. Methods of Chemical Analysis

7.1 Preparation of Sample

7.1.1 Compact the evaluation ingot sample taken in accordance with Section 6 into a consumable electrode and melt to ingot form in an arc furnace of a type conventionally used for reactive metals. The ingot shall be prepared for analysis by either of the following two methods:

7.1.1.1 Take a longitudinal section through the center of the ingot. Sample this section and analyze by appropriate means at a minimum of three places at approximately equal intervals diagonally from the top to the bottom of the section.

7.1.1.2 Samples for chemical tests shall be taken from solid metal below the surface porosity of the as-cast ingot. The samples shall be taken from a minimum of three places equally spaced along the axial length of the ingot.

7.2 Analytical samples for the determination of chlorine must be taken from the sponge, since this constituent is volatilized in melting. Obtain this sample by drilling a volumized sample of the sponge or chunklets. Sample the compacted sample of the sponge or chunklets. Sample the briquette by drilling, without water or other lubricant, a minimum of three holes, each 3/8 in. (9.53 mm) or larger in

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TABLE 1 Chemical Requirements of Zirconium Sponge, Reactor Grade R60901

Element	Percentage by weight, max, ppm
Aluminum	75
Boron	0.5
Calcium	0.5
Carbon	220
Chlorine	1300
Chromium	200
Cobalt	70
Copper	35
Fluorine	150
Iron	1500
Magnesium	50
Manganese	50
Molybdenum	70
Nickel	60
Niobium	1400
Oxygen	120
Silicon	50
Titanium	50
Vanadium	50
Zirconium Total	3.0

diameter, at equal intervals on a circle, concentric with the rounded surface of the briquette. Reject drillings until the flutes of the drill are $\frac{1}{16}$ in. (6.35 mm) below the surface of the briquette. Take the sample drillings from this point until the point of the drill is within $\frac{1}{16}$ in. of the opposite surface of the briquette. Crush drillings taken in this manner to pass a No. 4 (4760- μ m) sieve and thoroughly mix.

7.3 Analyze one of the samples taken in accordance with 7.1.1 for its uranium content. Analyze all samples taken in accordance with 7.1.1 for all elements listed in Table 1 except for chlorine and uranium.

7.4 Analysis—Analysis shall be made using the manufacturer's standard methods. In the event of disagreement as to the chemical composition of the metal, chemical analysis for referee purposes shall be determined by a mutually acceptable laboratory. The average of the analyses for each impurity shall conform to the requirements of this specification, with no individual value greater than 30 % above the maximum specified limit for that impurity. Practice E 29 shall be used to establish significant digits.

8. Particle Size

8.1 Zirconium sponge supplied under this specification shall pass a 1 in. (25.4 mm) screen and shall contain less than 2 %–20 mesh particles.

9. Reheat

9.1 If any sample or specimen exhibits obvious oxidation, or improper preparation, or flaws which disqualify it as a representative sample, the sample shall be discarded and a new sample or specimen resubmitted.

The American Society for Testing and Materials makes no position regarding the validity of any patent rights asserted in connection with any law mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and shall be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, PA 19103.

10. Rejection

10.1 Rejection for failure of the material to meet the requirements of this specification shall be reported to the manufacturer within 60 calendar days from the receipt of the material by the purchaser. Unless otherwise specified, rejected material may be returned to the manufacturer at the manufacturer's expense, unless the purchaser reports within three weeks of the notice of rejection, other arrangements for disposition.

11. Referee

11.1 In the event of disagreement between the manufacturer and the purchaser as to the performance of the material, the requirements of this specification or any special test specified by the purchaser, a mutually acceptable referee shall perform the tests in question. The results of the referee's testing shall be used in determining conformance of the material to this specification.

12. Certification

12.1 The manufacturer shall supply at least one copy of his analytical test results of chemical analysis and hardness tests on each lot or blend of material supplied. When quantities smaller than the manufactured standard test quantity are supplied, the blend analysis shall be considered representative of the lot.

13. Product Marking

13.1 The containers shall be legibly and permanently marked with the following information:

- 13.1.1 Purchase order number,
- 13.1.2 Name of material,
- 13.1.3 Particle size range,
- 13.1.4 Net weight,
- 13.1.5 ASTM designation, and
- 13.1.6 Date packed.

14. Packaging and Package Marking

14.1 The method of packaging shall be as agreed upon by the manufacturer and the purchaser. Packaging shall be such as to ensure safe delivery when shipped by any common carrier. The size and nature of the containers used are generally determined by the time and length of storage and the amount of handling involved. Where fire hazards or sponge deterioration during prepacked storage are primary considerations, zirconium sponge should be packed in air-tight, moisture-proof, sealed metal cans or drums which have been deaerated with argon.

15. Keywords

15.1 nuclear; virgin zirconium metal; zirconium sponge

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Scope

- 1.1 This spec and zirconium a
- 1.2 The value reported as the information only
- 1.3 The following test method does not pertain associated with this standard and its practices and definitions prior to 1

2. Referenced I

- 2.1 ASTM S
- 2.2 E 29 Practice Determine
- 2.114 Practice Examination

3. Classification

- 3.1 Ingots are
- 3.1.1 R60001
- 3.1.2 R60802
- 3.1.3 R60803
- 3.1.4 R60901

4. Ordering I

- 4.1 Order includes the following adequately the
- 4.1.1 Quantity
- 4.1.2 Name
- 4.1.3 Grade
- 4.1.4 Size (d)
- 4.1.5 ASTM

Note 1—A to dimension input ASTM Specification

This specifies Reactive and Ref. Substitution: 516 Current edition published as 9.104 2 Annual Book 2 Annual Book